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Reviews

Cognitive impairment in patients with chronic noncommunicable diseases: a review

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The aim of this review was to summarize the information about the specific weight and the clinical significance of cognitive impairment in the course and prognosis of major chronic noncommunicable diseases.

Materials and methods. Scientific literature from 2013 to 2018 on the cognitive impairment in patients with noncommunicable diseases was analyzed. Publications from previous years were taken into account in the absence of new research in this area or if conclusions have not lost relevance. Under the cognitive impairment dementia or mild cognitive impairment were understood.

Results Cognitive impairment is common for chronic cardiovascular diseases, both central nervous system and non-central nervous system cancer, chronic lung diseases, diabetes, and presented mostly from mild to moderate form. It can be caused by pathophysiological changes related to the underlying disease (in all diseases reviewed) or its treatment (in the case of cancer and diabetes), such as hypoxia, cerebral hypoperfusion, inflammation, acidosis etc. Cognitive impairment can reduce adherence to medication, self-management, recovery from disability; impact different social and daylife activities, such as academic performance, employing, driving, reading and other life aspects. For central nervous system cancer cognitive decline is also serve as an indicator of the tumor possible localization, a prognostic factor of survival and an indicator of the cancer recurrence.

Conclusions. Cognitive impairment is highly prevalent in patients with all major types of chronic noncommunicable diseases, with the executive function, memory and attention impaired most often. It reflects the severity of the underlying disease and its effect on the brain. Cognitive impairment can negatively affect the course, prognosis and treatment of major chronic noncommunicable diseases by reducing the management and self-management of therapy, adherence to therapy, quality of life, functional and social outcome and patient`s autonomy. Identification of cognitive impairment, development the ways to treat or compensate it, minimization of the poor cognitive function negative impact on course and prognosis is important for successful chronic noncommunicable diseases management.

Introduction

Noncommunicable diseases are the leading cause of death worldwide: they are responsible for about 70% of all deaths (41 million deaths each year) what makes them one of the main public health challenges in all countries [1, 2]. The main types of noncommunicable diseases, responsible for deaths worldwide, are cardiovascular diseases (422,7 million cases and 17,9 million deaths in 2015) [3], cancer (about 18,1 million cases and 9,6 million deaths in 2018) [4], chronic respiratory diseases (174,5 million cases and 3,2 million deaths caused by chronic obstructive pulmonary disorders; 358,2 million cases and 0,4 million deaths caused by asthma in 2015) [5], and diabetes (451 million cases and 5 million deaths in 2017) [6]. These noncommunicable diseases also often defines as chronic diseases [7].

There is increasing evidence that cognitive impairment can occupy a significant place in the clinical picture of all major types of chronic noncommunicable diseases [8-14, 74]. Poor cognitive function seem to be a risk factor of medication non-adherence [15, 75], poor self-management [12, 16, 76], reduced quality of life [12, 17, 76] and in some cases cognitive decline is associated with reduced patient`s survival [12].

Cognitive impairment in the early stages mostly is not diagnosed and is not taken into account when managing the patient until the formation of dementia states. However, the important thing is that progression from mild cognitive impairment (MCI) to severe dementia is not the only outcome: the decline can be stable or even reversible to normal cognition [18]. Changes in the diagnostic approaches to cognitive impairment, such as presented in Diagnostic and Statistical Manual of mental disorders, fifth edition (DSM-5), can significantly change the situation, leading to a more attentive attitude towards the cognitive decline. The importance of study, treatment and prevention of cognitive dysfunction is highlighted by adding in the DSM-5 the diagnosis of mild neurocognitive disorder in addition to major neurocognitive disorder (known previously as dementia) [19]. Replacement of the term “dementia” by “neurocognitive disorder” and usage of terms “mild” and “major” instead of “mild” and “severe” also highlighted the importance of overcoming the stigmatization and running the understanding that cognitive disorders worthy of clinical attention and intervention [20].

Thus, better understanding of relationship between cognitive impairment and noncommunicable diseases can give us two advantages. First, more effective management of chronic noncommunicable diseases to prevent\reverse the cognitive impairment can be provided. Second, early diagnosis and prevention\reversion of cognitive decline makes possible to reduce its impact on the course and prognosis of the disease by improving the patient`s self-management, adherence to therapy and a quality of life.

Aim

The aim of this review is to summarize the information about the specific weight and the clinical significance of cognitive impairment in the course and prognosis of major chronic noncommunicable diseases.

Materials and methods

The following databases to establish and identify the literature were used: Google Scholar, PubMed, Scopus, ScienceDirect. Scientific literature from 2013 to 2018 on the cognitive functioning in patients with noncommunicable diseases was analyzed. Publications from previous years were taken into account in the absence of new research in this area or authors are recognized experts on the subject and conclusions have not lost relevance.

Articles reporting cognitive impairment in people with one of main types of noncommunicable diseases (cardiovascular diseases, cancer, chronic respiratory diseases or diabetes) were eligible for inclusion. Articles reporting cognitive impairment due to delirium, neurodevelopmental cognitive deficits, neurodegenerative diseases preceding noncommunicable diseases, traumatic brain injury; or cognitive impairment in patients with other types of noncommunicable diseases were excluded. Also were excluded studies, reported about patients with serious comorbid mental disorders that can affect cognitive function. Reviews, original research, expert opinion were eligible for inclusion.

Search terms used were cognitive impairment; cognitive decline; cognitive disorder; cognitive function; cardiovascular diseases; cancer; chronic respiratory diseases; chronic obstructive diseases; diabetes.

Cognitive domains defined in the DSM-5 has been adopted [19]. Dementia or MCI were understood as cognitive impairment.

Results and discussion

Cognitive impairment in patients with cardiovascular diseases

Cardiovascular diseases include heart diseases, vascular brain diseases and diseases of blood vessels [21] and are highly associated with cognitive impairment [22].

Cognitive impairment and cardiovascular disorders share many vascular risk factors: smoking, hypertension, obesity, physical inactivity and diabetes are associated with decline in cognitive function and can be potential etiological factors for cognitive impairment in older population, especially when their influence appear in young adulthood and mid-life [8].

Cardiovascular diseases can lead to cognitive impairment by causing cerebral hypoperfusion, hypoxia, emboli, or infarcts [8, 22]. Endothelial dysfunction is associated with cognitive impairment in elder patients with cardiovascular diseases [23]. Some authors propose the conception of «heart-brain continuum hypothesis»: coronary artery disease, atrial fibrillation and chronic heart failure are connected into one cardiovascular continuum, leading to reduced cardiac output, increased platelet activity, thromboembolism as the main mechanisms of cognitive impairment in patients with cardiovascular disease [22].

Although it is known that cerebrovascular diseases are moderately to strongly associated with cognitive impairment [24], due to the frequent association of cerebrovascular diseases with Alzheimer's disease and other neurodegenerative diseases, we did not include studies describing the relationship of most vascular brain diseases and cognitive decline in the current review.

At the same time, stroke also classified by World Health Organization and US National Health Council as a chronic noncommunicable condition [7], and there is a sufficient amount of data on comorbid cognitive impairment, not associated with the development of Alzheimer's disease, what allowed us to include it in the current study. Cognitive impairment is common in stroke survivors [25]. In 83% of patients with stroke least one cognitive domain is impaired, and in 50% of patients there is impairment in more than 3 domains [26], and at least in 25% impairment is in form of dementia [25]. Most commonly memory, executive function and visuoconstructional cognitive domains are impaired [26]. At the same time cognitive impairment severity and cognitive domains involved may vary depending on stroke location and volume, degree of neuronal damage, existent cerebral diseases [25]. There is evidence that saved executive function in patients with stroke is a predictor of recovery from disability while memory, visuospatial ability and language didn`t show significant impact on rehabilitation [27]. Also, mild cognitive impairment is associated with better recovery, while dementia with worse [27].

Chronic heart failure, that remains an important cardiology issue [28], is a complication of many cardiovascular diseases, or counted among them. Cognitive decline presents in about 70% of patients with chronic heart failure and reduced left ventricular ejection fraction, mostly in the form of mild cognitive impairment [28]. Also, cognitive decline is associated with higher hospitalization and poor survival in patients with chronic heart failure and reduced left ventricular ejection fraction [29, 30]. According to Hilal et al. (2015), early markers of heart failure, such as amino terminal pro-brain natriuretic peptide and high sensitivity cardiac troponin, are associated with cognitive impairment with and without dementia in patients with cerebrovascular diseases [31]. This makes an interest in these markers to make early diagnosis and timely treatment of cognitive decline. Patients with chronic heart failure and cognitive impairment present difficulty with medication management and self-management (and even mild cognitive impairment may reduce the self-care) [22, 30]. Cognitive impairment in patients with chronic heart failure is also associated with comorbid coronary heart disease, comorbid hypertension and myocardial infarction [28]. At the same time, hypertension is seemed to be independently associated with cognitive impairment [30, 32].

Cognitive impairment, especially in the executive function and memory domains, presents in patients with coronary heart disease [33].

Atrial fibrillation also associated with cognitive impairment and is a strong risk factor for deterioration in cognitive function, the possible mechanisms may include cerebral hypoperfusion and silent cerebral ischemia due to decreased cardiac output, damage due to inflammatory agents and embolism [34].

Children and adolescent with congenital heart disease are at risk of impairment in executive function [35]. At the same time, with increasing quality and effectiveness of medical care, studying cognitive functioning in adult patients with congenital heart disease becomes relevant as well [36]. Although there is still little information that could be summarized, it seems that severity of congenital heart disease in adults is one of the factors that impair cognitive functioning, especially executive function and intelligence as complex cognition indicator [36].

Thus, cognitive impairment is common for many chronic cardiovascular diseases, such as coronary heart disease, chronic heart failure, atrial fibrillation, congenital heart disease etc. Cognitive decline may reflect the severity of the underlying disease and reflects the pathophysiological changes that occur in the body and affect the brain. Cognitive impairment can negatively impact the course and functional outcome of cardiovascular diseases by reducing medication management, self-management and recovery from disability.

Cognitive impairment in patients with cancer

Cognitive impairment is common in patients both with brain and non-central nervous system (CNS) cancer [37, 38], what makes the problem prevalent and important to study. Among the causes of impairment there are disease itself, cancer therapy, comorbid diseases, and even psychosocial stress [37].

Cognitive impairment often presents in patients with non-central nervous system cancer [37, 39]. The prevalence is ranging from 17% to over 70% [10]. Most research has focused on breast cancer, but other non-CNS cancers have also been studied and it seems that cognitive impairment is common to many cancer populations (e.g. breast cancer, leukemia, multiple myeloma, lymphoma, prostate carcinoma, colorectal carcinoma, ovarian carcinoma, prostate carcinoma, testicular cancer) [39, 10].

Changes in cognitive function due to cancer distinguished as «Cancer-related cognitive impairment (CRCI)» by some authors [9, 10]. CRCI is related primarily to deficits in domains of memory, attention (especially processing speed subdomain) and executive function. In other cognitive domains changes seem to be less significant [9, 39]. The degree of CRCI severity differs in adult patients with non-CNS cancer, but it is typically from mild to moderate [10] .

Among other cancer treatments chemotherapy seemed to have especial negative effect to cognitive function: decline can be detected in 75% of patients during it and in 35% cognitive impairment is still present months or years after the end of treatment [9]. The most prominent decline was reported in the domains of memory, attention and executive function [10], but the result largely depends on the comparison group, examined cognitive domains and pre-treatment assessment [40]. Other types of cancer treatment such as endocrine therapy and radiation therapy can also lead to cognitive impairment in similar domains but their effect on cognition is not as well studied [9, 10]. Post treatment cognitive deficits can be persisting [40], and impairment in attention and executive function may last longer than impairment in memory [41]. CRCI due to chemotherapy is mostly mild to moderate severity, but cognitive function can deteriorate to severe encephalopathy and dementia in some cases [10]. Also post-treatment cognitive impairment can be subtle to remain undetected or underestimated, that’s why it is important to make a pre-treatment assessment of cognitive function [9, 10]. Some studies report that cognitive function of patients who have been treated with chemotherapy was equivalent to that of patients who were 6 years older. The authors suggest that chemotherapy can accelerate cognitive aging [42].

CRCI can also be prior to treatment – more than 30% (40% in elderly population) adult patients with cancer experience cognitive dysfunction before any cancer therapy [9, 43]. Thus, it can be assumed that these patients have an increased risk of getting significant cognitive impairment after the start of cancer therapy.

The underlying etiology of CRCI is not well understood [9]. At the same time the neurobiological and neuroimaging correlates of chemotherapy-related cognitive impairment become increasingly clear. Some authors report about distinctive vulnerability of hippocampus to chemotherapy and radiotherapy as the possible cause of the high frequency of memory impairment in patients with cancer [37]. Also the structural changes in CNS after chemotherapy include decreased gray matter density and volume on MRI; white matter integrity and volume alteration on diffusion tensor imaging; post-treatment changes in brain activation during memory and executive tasks on fMRI [44]. As for the executive function, from 5 to 10 years after chemotherapy there is still a pattern of hypoactivation in prefrontal and parietal brain regions on fMRI occurring during executive functioning tasks that sometimes associated with cognitive impairment [45]. Episodic memory presented on fMRI by hypoactivation in prefrontal cortex and medial temporal lobe at encoding, followed by compensative widespread nonspecific hyperactivation at retrieval to overcome poor memory encoding [45].

Cognitive decline leads to negative changes in many areas of a patient’s life. Impairment in cognitive function can impact patient`s functioning, autonomy and decline the quality of life [38]. At the same time, higher quality of life correlated with better subjective cognitive function [46].

Acquired executive function impairment in adult patients may lead to reduced productivity, reduction in social functioning, community involvement and quality of life [10, 9]. CRCI is associated with a reduction in the ability to return to work (at all or to a limited capacity), driving and reading [9].

Cancer during a critical period can have a significant impact on cognitive functioning in the future adult life. Survivors, diagnosed cancer during childhood, adolescent and even early young adulthood (till 21 years) are at risk for cognitive impairment that may remain decades after treatment and lead to functional and social problems in adult life: they less likely graduate from college and attain post-school education, which is associated with impairment in executive function; they have risk for not maintaining full-time employment, which is associated with impairment in attention (processing speed); also they less likely live independently or being married [47, 48]. Impairment in executive function increase with time (for decades) after treatment for childhood cancer, what may be a result of altering the development of executive function in childhood or impact of cancer-associated chronic health conditions occur in adulthood [48].

Brain cancer take about 1,6% of all new cancer cases and lead up to 2,5% of death cases due to cancer [4]. Thus, CNS cancer, especially primary, is much less prevalent than non-CNS cancer. At the same time, cognitive impairment seem to be more common in patients with CNS cancer: decline of cognitive function represents one of the most frequent disturbanses, reported by patients, and observed in over 90% of patients with supratentorial brain tumours (even before start of treatment) [38].

As a rule, the nature and severity of cognitive impairment depends on tumour location [38, 49]. The location factor often make cognitive impairment specific and influence the characteristics of cognitive decline in patients with brain tumours [50]. This can make the characteristics of the decline largely individual and make it difficult to summarize information on the issue. There are reports that patients with CNS cancer obtain more severe cognitive impairment, that patients with non-CNS cancer [51], but the differences most likely depends on the study design.

Surgical treatment also affects cognitive function in patients with CNS cancer. Surgical resection of brain tumors itself can lead to cognitive impairment due to possible damaging of healthy tissue that surrounds tumor [38]. Chemotherapy and radiotherapy impact cognitive function in patients with CNS cancer as well [38, 52].

It seems that patients with CNS tumors also have a long-term cognitive impairment and its negative effect on the functional and social condition after years, moreover, radiotherapy may be a possible cause. [44, 53]. At the same time, no data exist about the long-term effects of chemotherapy on cognitive function in brain tumor patients [53].

Cognitive decline possibly serves as a prognostic factor of tumor progression and disease outcome. Early assessment of cognitive function, especially executive function and attention, in patients with brain metastases and primarily brain tumors can serve as independent prognostic factor of survival [37, 54]. Also cognitive dysfunction can be the first indicator of disease reoccurrence after treatment [52].

Thus, cognitive decline is a frequent occurrence in CNS and non-CNS cancer, often accompanying various types of cancer treatment and worsening the social and functional prognosis of patients. For CNS cancer cognitive decline is also serve as an indicator of the tumor`s possible localization, a prognostic factor of survival and an indicator of the recurrence of a tumor.

Cognitive impairment in patients with chronic lung diseases

Patients with chronic lung diseases seem to be at an increased risk of cognitive decline [12]. Among the main risk factors are hypoxia, hypercapnia and impaired lung function [12, 55]. Chronic obstructive pulmonary disease (COPD) and asthma appear to be the most studied for cognitive decline chronic lung diseases.

COPD is associated with an increased risk for cognitive impairment [56]. Prevalence of cognitive dysfunction in COPD vary from 10% to 61% [12]. At the same time there is evidence that 42% of nursing home patients with COPD have from moderate to severe cognitive impairment [57], what give us grounds for supposing that in case of insufficient autonomy and self-management cognitive deficit may be aggravated. Cognitive impairment in patients with COPD mostly present in the MCI form, at the same time depending on the severity of disease [58, 59]. Progression of COPD leads to progression in cognitive decline [58].

COPD lead to worsening hypoxia and hypercapnia, that negatively impact cognitive function, especially in patients with already exist mild cognitive dysfunction, and executive function deteriorates more than memory domain [57]. Saturation level lower than 91% seem to be a risk factor the occurrence of venous encephalopathy and cognitive impairment due to it [58].

Cognitive impairment in COPD significantly increases the need for support in many aspects of daylife (household activities, personal care, safety, transportation), treatment adherence and self-management [12, 60]. Cognitive decline can reduce the effectiveness of handheld inhaler treatment – near 50% of patients with mild cognitive impairment and 100% of patients with mild dementia could not operate with it properly [57]. At the same time cognitive impairment in COPD is associated with poor quality of life, hospitalization and reduced survival [12]. Coexistence of cognitive impairment and COPD also increases the risk of disability, and some authors suppose that identifying cognitive impairment may be as important as other areas of chronic obstructive pulmonary disease care [59].

Asthma is also associated with cognitive impairment [12]. Patients with asthma have a 78% increased risk for mild cognitive impairment and increased risk to have a dementia in the next decade of life [61, 62]. As in the case with COPD, severity of cognitive impairment also seems to depend on asthma severity and accompanying increased brain hypoxia [63].

In addition to the mechanisms already listed, certain contribution to the development of cognitive dysfunction in asthma patients can do also sleep disturbance, medication effects and systemic inflammation [12]. Interesting results were obtained when studying the size of the hippocampus in asthma. It was found that hippocampal volume in patients with asthma is significantly reduced and that cannot be explained by depression or corticosteroid use [64]. Thus, the effect of asthma on the brain structure and possible launching of neurodegenerative processes which impair cognitive functioning (especially memory), is assumed.

There is present data about impaired executive function in children with asthma and its association with adherence to medication [65]. Cognitive impairment also seems to reduce health literacy in older adults with asthma. This in its turn may lead to necessity of educational strategies use to improve self-management, including understanding and remembering physician`s instructions, adherence to multiple-drugs medication [66]. The risk of cognitive impairment also increasing with hospitalization frequency and aggravation of the disease [12].

Thus, cognitive impairment often accompanies chronic lung diseases, especially COPD and asthma, and depends on the severity of the underlying disease. It appears that cognitive decline may reflect a deterioration in oxygen supply to the brain and may be a prognostic factor for worsening of course and prognosis of chronic lung diseases. Also impairment in cognition, especially in executive function, can reduce the effectiveness of treatment and self-management, which also creates a risk for negative consequences.

Cognitive impairment in patients with diabetes

American Diabetes Association recognizes cognitive impairment in patients with diabetes as one of major adverse outcomes and a state needed a comprehensive medical evaluation [14].

Both type 1 and type 2 diabetes are associated with decrease in cognitive function from mild to moderate degree and also associated with structural and functional changes in brain [13]. From 54,5% to 63,6% of young adults with diabetes type 1 seem to have cognitive impairment, mostly in the mild form [67]. Patients with diabetes type 1 have deficits most commonly in domains of psychomotor speed, mental flexibility, attention and general intelligence, but processing speed, memory, visuospatial abilities and executive function also can decline [13]. Similar prevalence seems to be in patients with diabetes type 2 – from 47,8% to 67% seem to have cognitive decline, mostly in the form of mild cognitive impairment [68]. Patients with diabetes type 2 have identified deficits in many cognitive domains, particularly in executive function, memory and attention [13, 69]. Diabetes also serve as a risk factor for cognitive impairment in patients with cerebrovascular pathology [24].

Among factors that impact cognitive function in patients with diabetes type 2 there are hyper- and hypoglycemia, inflammation, hyperinsulinemia, cerebrovascular diseases, insulin resistance [13, 70, 71]. Hyperglycemia is a risk factor for mild cognitive impairment in patients with diabetes type 2, the mechanism may be an anaerobic metabolism due to hyperglycemia, leading to acidosis, hypoxia and damage to brain cells [13, 71]. One of the risk factors of cognitive decline is hypoglycemia due to poor glycemic control [14]. There is a bidirectional relationship between poor cognitive function and an increased risk of hypoglycemia in patients with both type 1 and type 2 diabetes [16]. Inadequate glycemic control can lead to hypoglycemia, and the latter, in turn, exacerbate the neurocognitive deficits, leading to occurrence of vicious circle. Both macro- and micro-vascular diseases, following diabetes, also associated with cognitive impairment [71]. Presence of diabetic retinopathy also associated with cognitive impairment in patients with diabetes, which can indirectly confirm the effect of microangiopathy on cognitive function [67]. Insulin resistance, leading to decreased glucose utilization in brain, may also lead to mild cognitive impairment, especially in domains of memory, attention and in orientation and calculation [71].

Diabetes therapy can also affect cognitive functioning, at least in patients with diabetes type 1. Therapy based on analogues of human insulin seem to have better cognitive performance, which may be due to fewer cases of hypoglycemia states [67]. Also, patients with a daily insulin dose more than 60IU seem to have worse performance in cognitive function, compared with the patients, receiving less than 40 IU insulin dose [67].

Cognitive decline negatively affects social and executive functioning in patients with diabetes. Presence of cognitive impairment significantly decreases the patients’ quality of life [16]. In children with type 1 diabetes poor cognitive function degrades the academic performance [72]. There are various reports about the degree of cognitive impairment influence on autonomy and daylife of patients, however, it’s common that this influence is present to some extent. Cognitive impairment from mild to moderate often doesn`t cause clinically significant problems in the daylife of most patients, but it may cause problems during stressful situations [13]. At the same time there are reports, that cognitive dysfunction can lead to inability to perform various components of self-management [73, 16]. The issue of self-control becomes especially important if to take into account that patients with diabetes need to involve lot of behaviors, that require the participation of different domains of cognitive function, especially executive function, to manage the illness (like glucose monitoring, recognition of hypoglycemia symptoms, performing the injections, adherence to medications diet and exercise timing). There are significant correlations between cognitive dysfunction and diabetes self-management, including mentioned behaviors. Thus, cognitive dysfunction has an impact on the whole diabetes management and self-management outcome, especially in the older people [16, 69]. This carries great risks for the course and outcome of the disease itself.

Thus, cognitive impairment is highly prevalent in diabetes patients, worsened with the progression of the disease and ineffective treatment. It can decrease quality of life, social function and self-management of patients. And degraded self-care can worsen course and prognosis of disease by impacting on diabetes treatment.

Conclusions

1. Cognitive impairment is common for the all major types of chronic noncommunicable diseases. Executive function, memory and attention are impaired most often.
2. Pathophysiological changes in chronic noncommunicable diseases can affect the brain, causing symptoms in the form of a cognitive decline, thus, cognitive impairment reflects the severity of the underlying chronic disease and its systemic effect on the organism.
3. Cognitive impairment negatively affects the course, prognosis and treatment of major chronic noncommunicable diseases by reducing the management and self-management of therapy, adherence to therapy, quality of life, functional and social prognosis and patient`s autonomy.
4. Identification of cognitive impairment, development the ways to treat or compensate it, minimization of the poor cognitive function negative impact on course and prognosis is important for successful chronic noncommunicable diseases management.

At the same time, there are still unresolved issues. Due to the different approach to the diagnosis of cognitive impairment, it remains an open question to form a basic set of neuropsychological tests for a primary medical network, that will be sensitive to cognitive changes of different (but not just Alzheimer's) etiology, especially in the mild forms. There are also a lot of open issues concerning the mechanisms of cognitive impairment occurrence in various chronic noncommunicable diseases, so the continuation of the search in this direction also remains promising. Also promising is the study of how the impact on cognitive function, especially executive function, will affect the patient`s functional outcome, autonomy and management of the disease, as well as how much the impact on cognitive functions allows to improve the course and prognosis of the disease. We assume, that by improving cognitive functioning, the executive function in particular, it is possible to improve the disease management and the functional outcome in patients with chronic non-communicable diseases. In this case, as diagnostic targets can serve the sub-domains of cognitive functions that can affect the self-management, patient autonomy, therapy adherence and decision making.

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